Historic, Archive Document

Do not assume content reflects current scientific knowledge, policies, or practices

A64.9
R31A
#21
copy 2

CROPS RESEARCH — ARS 34-21

Control of

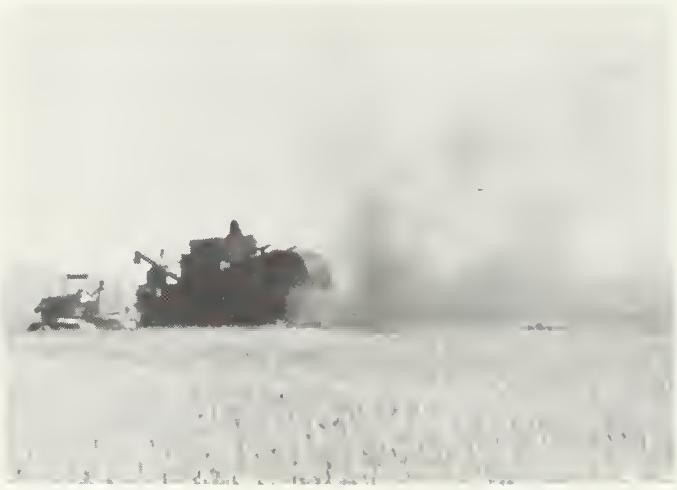
# Common Bunt of Wheat by Seed Treatment

in the Pacific Northwest

ARTMENT OF AGRICULTURE
LIBRARY
1962

May 1961

Agricultural Research Service
U. S. DEPARTMENT OF AGRICULTURE



A wheat harvest scene in the Pacific Northwest demonstrating a spore cloud produced by the harvester operating in a field heavily infested with smut.

# CONTROL OF COMMON BUNT OF WHEAT BY SEED TREATMENT IN THE PACIFIC NORTHWEST[1]

Laurence H. Purdy[2]

## SUMMARY

Thirty-two different commercially available chemical formulations were tested as seed treatments for control of common bunt over a 5-year period (1955-1959) in the Pacific Northwest. Formulations of hexachlorobenzene (HCB) and mercury compounds were the most effective against seed-borne smut. Pentachloronitrobenzene (PCNB), copper carbonate, and a carbamate were less effective. HCB was the most effective material tested for the control of soil-borne bunt and for the simultaneous control of seed-borne plus soil-borne bunt. PCNB was less effective than HCB, whereas all mercurials included in tests with soil-borne or seed-borne plus soil-borne inoculum were completely ineffective.

## INTRODUCTION

In the Pacific Northwest where common bunt (Tilletia caries (DC.) Tul. and T. foetida (Wallr.) Liro) of wheat is a major problem, the disease is perpetuated from one crop to the next by spores carried on the seed and by spores in the soil. Contamination of the seed and soil occurs when the spore balls from smut-infected wheat heads are broken up in the threshing process. The harvesting of a heavily infected field of wheat liberates enormous quantities of spores. Some of these adhere to the threshed grain in the threshing machinery and some, through the settling of smut spore clouds, contaminate the soil of summer-fallow fields scheduled for fall seeding. Consequently, successful control of common bunt depends on prevention of infection of the wheat seedling by spores from both of these sources, either by chemical treatment of the seed or by growing bunt-resistant varieties. Fungicide developments of recent years have materially enhanced the potential for control of common bunt by chemical treatment of seed.

Wheat seedlings are susceptible to infection by T. caries and T. foetida throughout the pre-emergence stages of their development. To protect seedlings against infection during all this period, a seed-treatment fungicide must be effective well beyond the immediate vicinity of the seed. None of the standard seed-treatment fungicides used in the Pacific Northwest before 1954 provided that protection. Thus, for many years the crux of the common bunt problem in this region was the ineffectiveness of mercury, copper, and formaldehyde fungicides against infection by soil-borne inoculum. This deficiency in seed-treatment fungicides was apparently overcome with the advent of the polychlorobenzenes, some of which have been under test in the Pacific Northwest since 1951.

## MATERIALS AND METHODS

Orin, a soft white, common-type winter wheat, was planted at all locations in all tests. The seed of this variety was inoculated with spores of race T-16 of T. caries at the rate of 1/2 to 1 gram of spores per 100 ml. of seed in tests in which seed-borne inoculum was used. In tests involving soil-borne inoculum, the soil was inoculated by spraying open furrows with a spore suspension to apply 1 gram of spores per 10 feet of row.

---

[1] Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the Agricultural Experiment Stations of Idaho, Montana, Oregon, Utah, and Washington. Scientific Paper No. 1909, Washington Agricultural Experiment Station.

[2] Pathologist, Crops Research Division, ARS, U. S. Department of Agriculture, Regional Smut Research Laboratory, at Washington Agricultural Experiment Station, Pullman, Wash.

The chemical formulations tested, the trade names and the manufacturers[3] are listed below:

40% hexachlorobenzene--Anticarie 40. H. P. Rossiger Company, Inc.
80% hexachlorobenzene--Anticarie 80. H. P. Rossiger Company, Inc.
7.7% N-(ethylmercuri)-p-toluenesulfonanilide--Ceresan M. E. I. du Pont de Nemours & Co.
2.8% ethylmercury 2,3-dihydroxypropyl mercaptide and 0.6% ethylmercury acetate--Ceresan 75. E. I. du Pont de Nemours & Co.
3.1% ethylmercury 2,3-dihydroxypropyl mercaptide and 0.6% ethylmercury acetate--Ceresan 100.
6.0% ethylmercury 2,3-dihydroxypropyl mercaptide and 1.3% ethylmercury acetate--Ceresan 200.
5.41% methylmercury nitrile--Chipcote 25. Chipman Chemical Co., Inc.
1.85% methylmercury nitrile--Chipcote 75. Chipman Chemical Co., Inc.
56% copper carbonate--Copper carbonate.
10.34% N-ethylmercuri-1,2,3,6-tetrahydro-3,6-endomethano-3,4,5,6,7,7 hexachlorophthalimide.--Emmi (Liquid). Velsicol Corp.
10% active ingredient--Emmi (Powder). Velsicol Corp.
20.6% heptachlor and 1% phenylmercury acetate.--Heptachlor + PMA.

11.4% methoxyethylmercury acetate--Mema.
10% phenylmercury salicylate--Merculine 100.
7% phenlmercury acetate--Mer-sol.
35.9% pentachloronitrobenzene--Monsanto Liquid PCNB. Monsanto Chem. Co.
40% hexachlorobenzene--No Bunt 40. Chipman Chemical Company, Inc.
80% hexachlorobenzene--No Bunt 80. Chipman Chemical Company, Inc.
2.25% methylmercury 8-hydroxyquinolate--Ortho LM Seed Protectant. California Spray-Chemical Corp.
7.5% methylmercury 8-hydroxyquinolate--Ortho LM Seed Protectant (Concentrate). California Spray-Chemical Corp.
5.7% methylmercury 8-hydroxyquinolate--Ortho LM Seed Protectant (Dry). California Spray-Chemical Corp.
2.2% cyano (methylmercuri) guanidine--Panogen 15. Panogen Company Division, Morton Chemical Co.
6.3% cyano (methylmercuri) guanidine--Panogen 42. Panogen Company Division, Morton Chemical Co.
40% hexachlorobenzene--Sanocide. California Spray-Chemical Corp.
7% phenylmercury acetate--Setrete. California Spray-Chemical Corp.
7% phenylmercury acetate--Smut B Gon.
40% hexachlorobenzene--Smut Go 40. Miller Products Co.
80% hexachlorobenzene--Smut Go 80. Miller Products Co.
40% hexachlorobenzene--Stauffer HCB-40. Stauffer Chemical Co.
75% pentachloronitrobenzene--Terraclor.
25% pentachloronitrobenzene--Terraclor Liquid.
30% sodium dimethyldithiocarbamate and sodium derivative of 2-mercaptobenzothiazole--Vancide 51.

The seed was treated in units of 250 ml. Wettable powders were applied as slurries and liquid formulations either in a diluted form at rates of application 1/5 to 1 ounce per bushel or in an undiluted concentrated form at rates of 2 to 4-1/2 ounces per bushel. To apply wettable powders at the 1/2-ounce rate, 120 mg. of the fungicide was placed in a vial with 2 ml. of water and 2 to 4 drops of 5 percent methylcellulose to act as a stickerspreader. The contents of the vial were then made into a slurry and poured into a 1-liter erlenmeyer flask containing the unit of seed to be treated. The fungicide was distributed over the seed by shaking and rotating the flask vigorously until all visible moisture was removed from the inner wall of the flask. Higher or lower rates of application were made by increasing or decreasing proportionately the amount of fungicide used to make the slurry.

---

[3] The mention of a trade product or manufacturers does not imply its endorsement by the U. S. Department of Agriculture over similar products or firms not named.

Liquid fungicides applied at the 1/2-ounce rate were first diluted with water in a ration of 1 part of fungicide to 16 parts of water, and 2 ml. of this dilution was used to treat one unit of seed. Higher or lower rates of application were made by altering the dilution ratio accordingly. Direct applications of undiluted or concentrated fungicides were made by using 0.42 ml. of the fungicide to treat a unit of seed at the rate of 2 fluid ounces per bushel. Higher or lower rates of direct application were made by increasing or decreasing the amount of fungicide used.

After treatment the seed were kept in paper bags and then placed in seed envelopes and held until planting. Seventy-five different chemical formulations were tested in 37 different experimental plots .during a 5-year period, 1955 through 1959. However, the results obtained with only 32 materials available commercially are reported.

The treated seed were planted in randomized 10-foot rows with 3 replications of each treatment at each location. The relative effectiveness of the various treatments was measured in terms of bunt percentages, based on counts of 200 heads per row in 1955 and thereafter on the total number of heads per row.

## RESULTS

The results obtained, as mean percentages of bunt, and the number of years each material was tested for the control of soil-borne, seed-borne, and seed-borne plus soil-borne common bunt are summarized in Tables 1, 2, and 3, respectively. Over the 5-year test period an average of 77.3 percent bunt developed in the untreated check rows in the tests for the control of infection from seed-borne spores (Table 2). Thus, severe conditions were provided for the evaluation of new materials. Three formulations of 40 percent hexachlorobenzene (HCB) (Anticari 40, No Bunt 40, and Sanocide) applied to the seed at the rate of 1 ounce per bushel, and 2 mercurial fungicides (Ceresan M at 1/2 ounce and Panogen 15 at 3/4 ounce per bushel) were included in all tests over the 5-year period. These materials effectively controlled infection from seed-borne spores and served as "standard" materials with which new formulations were compared. In general, all the mercurials tested provided good control; there were some indications that the ethyl and methyl forms of mercury were more effective against seed-borne bunt than the phenyl mercuries. Of the non-mercurials included in the tests, HCB was the most effective and was comparable with the mercurials. Formulations of pentachloronitrobenzene (PCNB) provided poorer control than either the mercurials of the HCB formulations and were only slightly more effective than Vancide 51, a carbamate, which provided inadequate control.

Percentages of infection in the tests for the control of soil-borne bunt averaged 59.1 percent in the untreated check rows over the 5-year period (Table 1). Good control was obtained with the 40 percent HCB formulations at 1 and 2 ounces per bushel, the 80 percent HCB formulations at 1/2 ounce, and Terraclor at 2 ounces per bushel. Only fair control was provided by 1/2-ounce and 1-ounce rates of Terraclor and Monsanto Liquid PCNB at 2 ounces. Terraclor Liquid and the mercurials in these tests failed to control bunt that originated from soil-borne inoculum, confirming the report of 1954 that mercurials are not effective against the soil-borne phase of this disease.

Results obtained from the tests for the simultaneous control of seed-borne and soil-borne bunt (Table 3) show that an average of 79.1 percent bunt developed in the untreated check rows. As in the tests for the control of soil-borne bunt alone (Table 2), the 40 percent formulations of HCB at 1 and 2 ounces and the 80 percent HCB formulations at the 1/2-ounce rate effectively controlled bunt in these tests (Table 3). Terraclor at 2 ounces was again comparable with the 40 percent HCB formulations at 1 ounce per bushel. The other applications of PCNB formulations provided only fair control. The percentages of bunt that developed in these tests with the mercurials (Table 3) and in those for the control of soil-borne bunt alone (Table 1) were about the same, indicating that the mercurials controlled seed-borne bunt but failed again to control the soil-borne phase.

These results substantiate on a regional scope the report of 1954 that seed treatment with HCB effectively reduces the incidence of bunt from soil-borne inoculum, a property that no other seed treatment fungicide is known to possess. Furthermore, from these data a rate of 1 ounce per bushel of the 40 percent HCB formulations was established as the minimum application rate for effective control of infection by seed-borne and soil-borne spores. Any lesser rate of application reduces the probability of adequate seed coverage by commercial treating operations. Complete coverage of the treated seed is prerequisite for effective control by seed treatment. Thus, the full potential of seed treatment with HCB for wheat smut control in the Pacific Northwest depends on a seed-treatment process that provides adequate coverage of the seed with the fungicide.

TABLE 1.--A 5-year summary of results, as mean percentages of bunt, from regional seed-treatment tests for the control of SOIL-BORNE common bunt of winter wheat in the Pacific Northwest, 1955-1959.

| Treatment | Form[1] | Ounces per bushel | Mean bunt percentage | Years tested |
|---|---|---|---|---|
| None (Check) | - | - | 59.1 | 5 |
| Anticarie 40 | W | 1/2 | 5.6 | 1 |
| Do | W | 1 | 2.8 | 5 |
| Do | W | 2 | 1.6 | 2 |
| Anticarie 80 | W | 1/2 | 1.9 | 1 |
| Ceresan 75 | L | 3/4 | 37.4 | 1 |
| Ceresan 200 | L | 1/4 | 45.2 | 1 |
| Emmi | L | 1/2 | 32.4 | 1 |
| Do | L | 1 | 23.8 | 1 |
| Monsanto Liquid PCNB | L | 2 | 6.3 | 1 |
| No Bunt 40 | W | 1/2 | 8.3 | 1 |
| Do | W | 1 | 2.5 | 5 |
| Do | W | 2 | 1.4 | 2 |
| No Bunt 80 | W | 1/2 | 2.6 | 4 |
| Ortho L M Seed Protectant (Concentrate) | L | 1/4 | 56.3 | 1 |
| Panogen 15 | L | 3/4 | 42.1 | 5 |
| Do | L | 1 1/2 | 29.8 | 2 |
| Panogen 42 | L | 1/5 | 57.2 | 1 |
| Sanocide | W | 1/2 | 7.7 | 1 |
| Do | W | 1 | 2.0 | 5 |
| Do | W | 2 | 1.5 | 2 |
| Smut Go 40 | W | 1 | 5.4 | 3 |
| Smut Go 80 | W | 1/2 | 2.5 | 2 |
| Stauffer HCB-40 | W | 1 | 3.3 | 2 |
| Terraclor | W | 1/2 | 11.1 | 1 |
| Do | W | 1 | 6.3 | 4 |
| Do | W | 2 | 1.6 | 2 |
| Terraclor Liquid | L | 2 1/4 | 22.0 | 1 |

[1] L = liquid; W = wettable powder; D = dust.

TABLE 2.--A 5-year summary of results, as mean percentages of bunt, from regional seed-treatment tests for the control of SEED-BORNE common bunt of winter wheat in the Pacific Northwest, 1955-1959.

| Treatment | Form[1] | Ounces per bushel | Mean bunt percentage | Years tested |
|---|---|---|---|---|
| None (Check) | - | - | 77.3 | 5 |
| Anticarie 40 | W | 1/2 | 1.7 | 2 |
| Do | W | 1 | .3 | 5 |
| Anticarie 80 | W | 1/2 | .8 | 1 |
| Ceresan M | W | 1/2 | .1 | 5 |
| Ceresan 75 | L | 3/4 | .2 | 3 |
| Ceresan 100 | L | 1/2 | .4 | 1 |
| Ceresan 200 | L | 1/4 | .1 | 2 |
| Chipcote 25 | L | 1/4 | .8 | 1 |
| Chipcote 75 | L | 3/4 | .2 | 1 |
| Copper carbonate | D | 2 | 34.0 | 1 |
| Do | W | 2 | 25.1 | 1 |
| Emmi | L | 1/4 | 1.1 | 1 |
| Do | L | 1/2 | .1 | 5 |
| Do | W | 1/2 | .4 | 4 |
| Heptachlor + PMA (Calif. Spray) | L | 4 1/2 | 3.9 | 2 |
| Mema | L | 1/4 | .9 | 3 |
| Merculine 100 | L | 1/2 | 1.4 | 3 |
| Mer-sol | L | 1/2 | .6 | 3 |
| Monsanto Liquid PCNB | L | 2 | 5.2 | 2 |
| No Bunt 40 | W | 1/2 | 2.7 | 2 |
| Do | W | 1 | .7 | 5 |
| No Bunt 80 | W | 1/2 | 1.4 | 4 |
| Ortho L M Seed Protectant | L | 3/4 | .4 | 2 |
| Ortho L M Seed Protectant (Concentrate) | L | 1/4 | .1 | 1 |
| Ortho L M (Dry) | W | 1/2 | .1 | 1 |
| Panogen 15 | L | 3/4 | .1 | 5 |
| Panogen 42 | L | 1/5 | .1 | 4 |
| Sanocide | W | 1/2 | 4.8 | 2 |
| Do | W | 1 | .7 | 5 |
| Setrete | L | 1/2 | 1.6 | 3 |
| Smut B Gon | L | 1/2 | .6 | 2 |
| Smut Go 40 | W | 1/2 | .7 | 1 |
| Do | W | 1 | .9 | 4 |
| Smut Go 80 | W | 1/2 | .5 | 2 |
| Stauffer HCB-40 | W | 1 | 5.9 | 2 |
| Terraclor | W | 1 | 2.4 | 4 |
| Terraclor Liquid | L | 2 1/4 | 20.2 | 1 |
| Vancide 51 | L | 4 | 13.9 | 1 |

---

[1] L = liquid; W = wettable powder; D = dust.

TABLE 3.--A 5-year summary of results, as mean percentages of bunt, from regional seed-treatment tests for the simultaneous control of SEED-BORNE and SOIL-BORNE common bunt of winter wheat in the Pacific Northwest, 1955-1959.

| Treatment | Form[1] | Ounces per bushel | Mean bunt percentage | Years tested |
|---|---|---|---|---|
| None (Check) | - | - | 79.1 | 5 |
| Anticarie 40 | W | 1/2 | 7.3 | 1 |
| Do | W | 1 | 2.6 | 5 |
| Do | W | 2 | 1.7 | 2 |
| Anticarie 80 | W | 1/2 | 3.3 | 1 |
| Ceresan 75 | L | 3/4 | 47.2 | 1 |
| Ceresan 200 | L | 1/4 | 56.6 | 1 |
| Emmi | L | 1/2 | 26.4 | 1 |
| Do | L | 1 | 23.7 | 1 |
| Monsanto Liquid PCNB | L | 2 | 4.1 | 1 |
| No Bunt 40 | W | 1/2 | 9.8 | 1 |
| Do | W | 1 | 3.3 | 5 |
| Do | W | 2 | 1.8 | 2 |
| No Bunt 80 | W | 1/2 | 5.7 | 4 |
| Do | W | 1 | 1.6 | 1 |
| Ortho L M Seed Protectant (Concentrate) | L | 1/4 | 43.5 | 1 |
| Panogen 15 | L | 3/4 | 41.0 | 5 |
| Do | L | 1 1/2 | 28.7 | 2 |
| Panogen 42 | L | 1/5 | 50.5 | 1 |
| Sanocide | W | 1/2 | 12.7 | 1 |
| Do | W | 1 | 3.2 | 5 |
| Do | W | 2 | 3.0 | 2 |
| Smut Go 40 | W | 1 | 4.0 | 3 |
| Smut Go 80 | W | 1/2 | 5.2 | 2 |
| Stauffer HCB-40 | W | 1 | 10.4 | 2 |
| Terraclor | W | 1/2 | 19.0 | 1 |
| Do | W | 1 | 5.6 | 4 |
| Do | W | 2 | 1.8 | 2 |
| Terraclor Liquid | L | 2 1/4 | 26.2 | 1 |

[1] L = liquid; W = wettable powder.

UNITED STATES DEPARTMENT OF AGRICULTURE
1862 1962
Growth Through Agricultural Progress